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COMMISSION

NATURAL GAS ASSESSMENT UPDATE

STAFF REPORT

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Arnold Schwarzenegger, *Governor*

CALIFORNIA ENERGY COMMISSION

Mignon Marks
Mark Di Giovanna,
Principal Authors

Mignon Marks,
Project Manager

Dave Maul,
Manager
Natural Gas and Special Projects Office

Rosella Shapiro,
Deputy Director
Fuels and Transportation Division

Robert L. Therkelsen
Executive Director

Note: This report was prepared using information in the adopted *2003 Integrated Energy Policy Report*. The staff has initiated its next natural gas assessment for the *2005 Energy Report*, to be adopted in November 2005. The information and numbers in that upcoming report may be different than that contained in this current report.

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Executive Summary

California's large demand for natural gas and its dependence on interstate pipelines for imported sources of natural gas supply have been the subject of broad public policy debate. During the 1980s and 1990s, North American natural gas supplies exceeded demand and, as a result, prices were stable and low. Today, natural gas imported to California from the Western U.S. and Canada is more expensive. The California Energy Commission (Energy Commission) is concerned about the impact of recent increases in natural gas prices, which in 2004 were double what they were in 2002 and earlier years, upon California consumers and the state's economy. This report discusses California's current natural gas situation and options to address rising natural gas prices in California.

Unless otherwise noted, all natural gas demand, supply, and price projections are from the California Energy Commission's *2003 Energy Report*. These projections will be updated in the *2005 Energy Report.*

California residents and businesses consume large quantities of natural gas every day. California's total annual consumption, approximately 2.2 trillion cubic feet, would make this state the tenth largest natural-gas consuming "country" in the world.

The state's industrial and electricity-generation sectors consume the most natural gas, approximately 66 percent of the total amount. Natural gas used for electricity generation is the largest contributor to the state's growing demand rate, one percent per year.

Factors contributing to growing natural gas demand in California include:

- Most of the large, thermal power plants built recently in California are fueled by natural gas. Natural gas-fired power plants are preferred, because they emit less air pollution and are more cost effective compared to other fossil-fueled generation technology (i.e., lower capital and operating costs).

- The state's population is growing and most new homes and buildings have air conditioning and natural gas heating. Natural gas is burned in summer to meet peak electrical demand for air conditioning and in winter for space heating.

California must import most of its natural gas supply, approximately 85 percent. These imports flow hundreds of miles within interstate pipelines from four major supply basins located in the Southwest, Rocky Mountains region, and Western Canada.

For the past 50 years, California has enjoyed minimal competition from the other Western states for natural gas supplies and for interstate pipeline capacity. Today, California must compete for natural gas supplies with fast-growing Western states such as Nevada, Arizona, and New Mexico, as well as the Midwest.

California's dependence on imports will increase, because in-state natural gas production is slowly declining and only meets 15 percent of the state's total natural gas demand. Total U.S. production from conventional sources has flattened despite increases in drilling and wellhead prices. Canada's natural gas production statistics indicate similar resource depletion trends.

Remaining North American natural gas supplies will be more costly, because the less expensive resources have already been produced. Drilling new wells costs more and produces less natural gas per well. As a result, the number of wells drilled each year must increase to maintain the current level of production.

The tight natural gas supply situation impacts prices. Wholesale natural gas prices in California and the U.S. have doubled since July 2001.

Rising natural gas prices directly affect California's economy and consumers. High gas prices increase consumers' cost of living and reduce their purchasing power for other goods and services. Californians feel the effects of rising natural gas prices with more expensive home heating and electricity bills, and higher prices for food and consumer goods. Higher natural gas prices add to the cost of California-made products, making in-state businesses less competitive in the global marketplace.

The *2003 Energy Report* identified strategies to address California's natural gas supply, demand, and price challenges. These strategies included increasing energy efficiency, installing more renewable energy electricity-generating facilities, producing more domestic natural gas supplies, and importing natural gas from new supply sources.

To make more efficient use of existing natural gas supplies, the *2003 Energy Report* recommended increasing energy efficiency programs that reduce both natural gas and electricity use. The State should also pursue strategies to generate 30 percent of its electricity from renewable energy. Even with these aggressive actions, however, the statewide demand for natural gas will continue to grow by at least one percent per year requiring additional natural gas imports into the state.

Drilling for unconventional resources, such as coalbed methane could increase North American natural gas supplies. Advances in technology are necessary, however, for developing these unconventional, expensive resources. In addition

to developing coalbed methane, the natural gas industry is proposing to develop Arctic gas from Alaska and the MacKenzie Delta region in Canada. To transport this gas to California, pipelines and other infrastructure must be constructed from these remote regions. These projects will not be completed for at least 10 years.

Another option is to import natural gas from remote reserves in Pacific Rim regions, such as Alaska, Australia, Indonesia, and Russia. To access these natural gas supplies, the West Coast must have liquefied natural gas receiving terminal(s). Liquefied natural gas facilities have been proposed for Washington, Oregon, California, British Columbia, and Baja California, Mexico.

Chapter 1: Natural Gas Use in California

California consumes approximately 6 billion cubic feet of natural gas per day and during some months this demand peaks to 10 billion cubic feet per day. If California were a country, it would rank as the tenth largest user of natural gas worldwide.

While electricity generation and industrial consumers are the largest users of natural gas, natural gas availability and prices also impact the residential and commercial sectors. Figure 1 shows the proportion of natural gas used by each sector, based on consumption averages between 1997 and 2002.

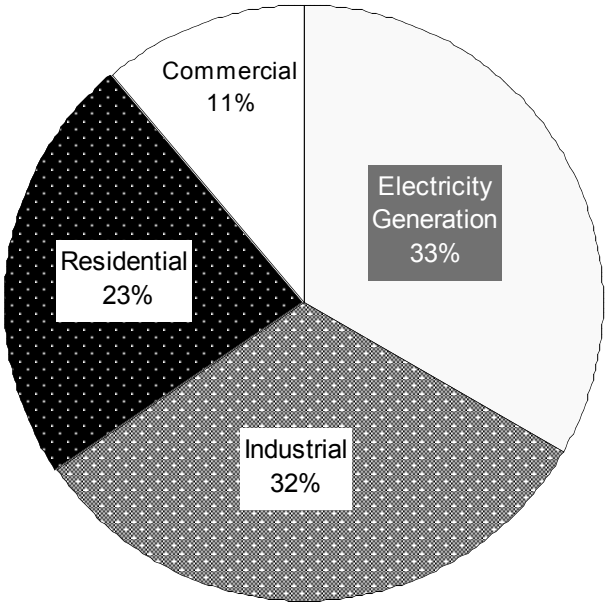

Figure 1: Natural Gas Consumed in California by Sector
Source: U.S. Energy Information Administration[1]

Natural Gas Consumption by Residential and Commercial Customers

Residential and commercial customers account for 34 percent of California's natural gas consumption, with residential customers representing two-thirds of that amount. Both use natural gas primarily for space heating and water heating.

Figure 2 shows that 88 percent of residential natural gas consumption is used for space and water heating.

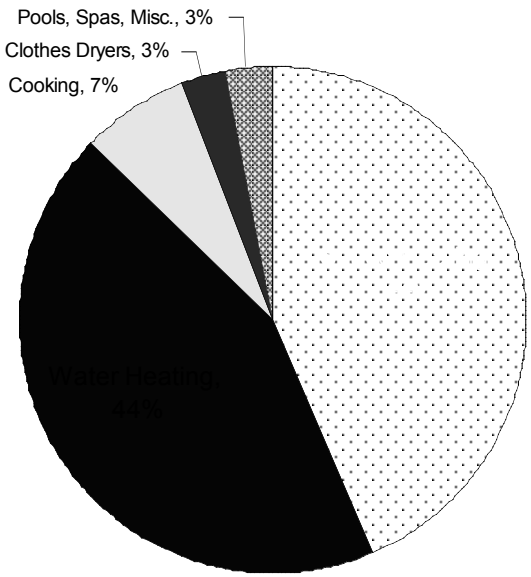

Figure 2: Residential Natural Gas Consumption by End Use
Source: *California Statewide Residential Appliance Saturation Study*[2]

In the late 1970s, the majority of homes had electric ovens and clothes dryers and nearly half of all homes had electric stoves. In the early 1980s, however, the proportion of electrical-appliance use began to decline, so that today more California homes use natural gas appliances.

Figure 3 shows the current overall percentage of electrical and natural gas appliances. Except for spas and barbeques, natural gas is the dominant fuel supply for most residential appliances. Natural gas fireplaces are also replacing wood fireplaces in many homes.

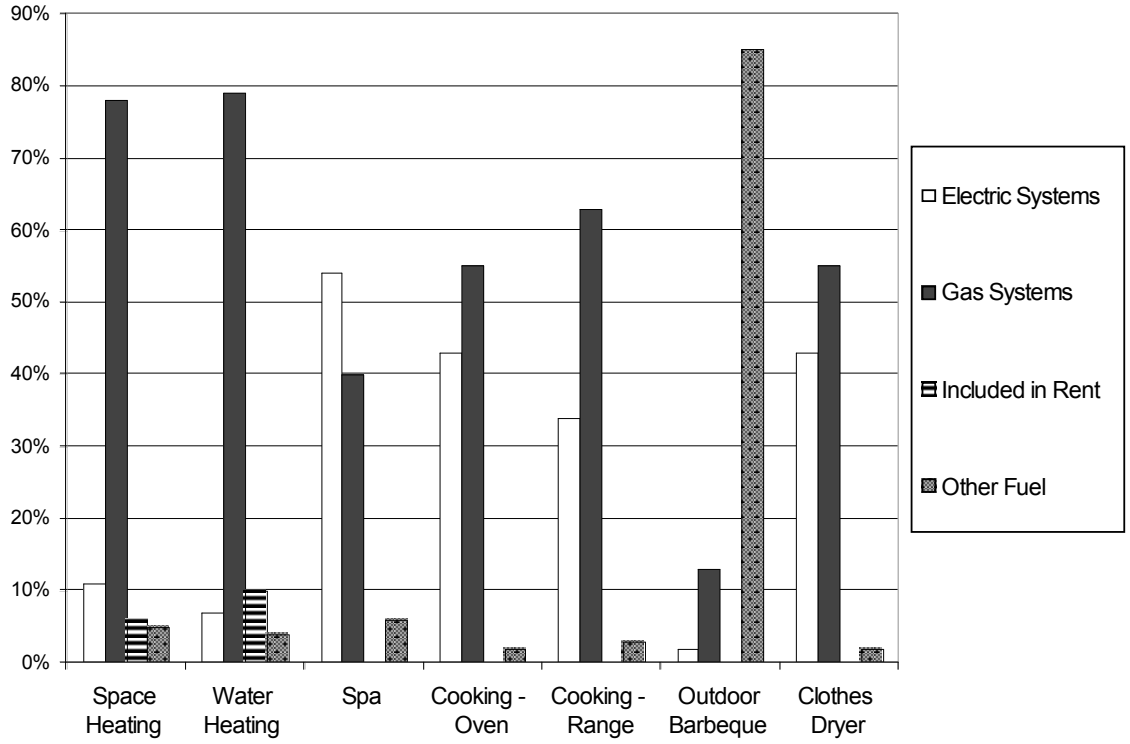

Figure 3: Overall Shares of Electrical, Natural Gas Systems in California Homes
Source: *California Statewide Residential Appliance Saturation Study*[3]

The shift to natural gas appliances is partly due to California's Building Energy Efficiency Standards that discourage using electrical space heaters and water heaters in areas where natural gas service is available. California's gas utilities have also played a role in this transformation. For instance, Southern California Gas Company's "Energy Advantage Homes" program offers marketing support to homebuilders that install a minimum of six natural gas appliances and/or outlets.[4] Finally, consumers may prefer natural gas appliances because they are more economical to operate than their electrical equivalents.

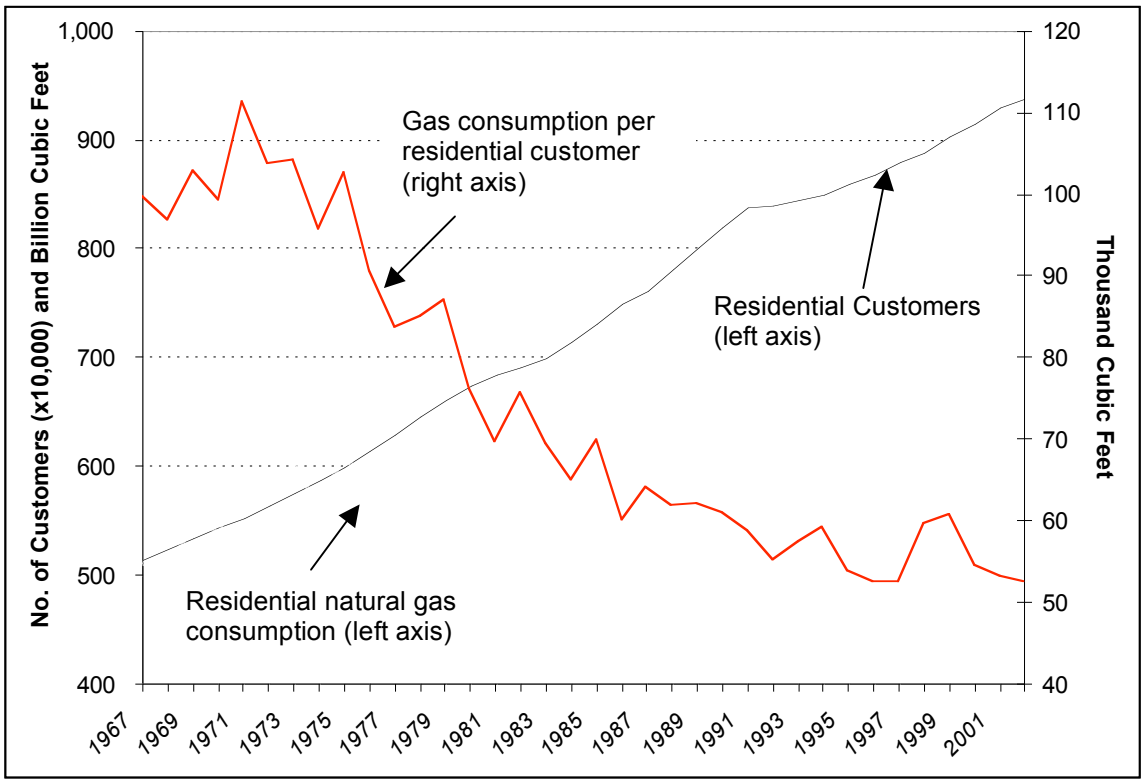

Figure 4: Residential Natural Gas Consumption and Population Growth Trends
Source: California Energy Commission

Since 1967 the number of households in California has nearly doubled from 5 million to more than 9 million. Total residential natural gas consumption, however, has remained relatively flat at about 500 billion cubic feet per year (Figure 4). Per household natural gas use has dropped dramatically since the Energy Commission first adopted building and appliance efficiency standards in 1978. The average household's natural gas consumption is less than half of what it was thirty-five years ago even with our state's larger homes and more natural gas appliances.

Figure 5 compares annual natural gas consumption per residential customer in the U.S. and California. It shows that California's residential consumers use approximately one-third less natural gas per customer annually than is used by residential customers, nationwide. Between 1997 and 2002, U.S. per capita natural gas use averaged 820 therms, while in California the average use was only 558 therms. Factors contributing to lower natural gas use by residential customers in California include its energy efficiency programs and standards and relatively mild climate.

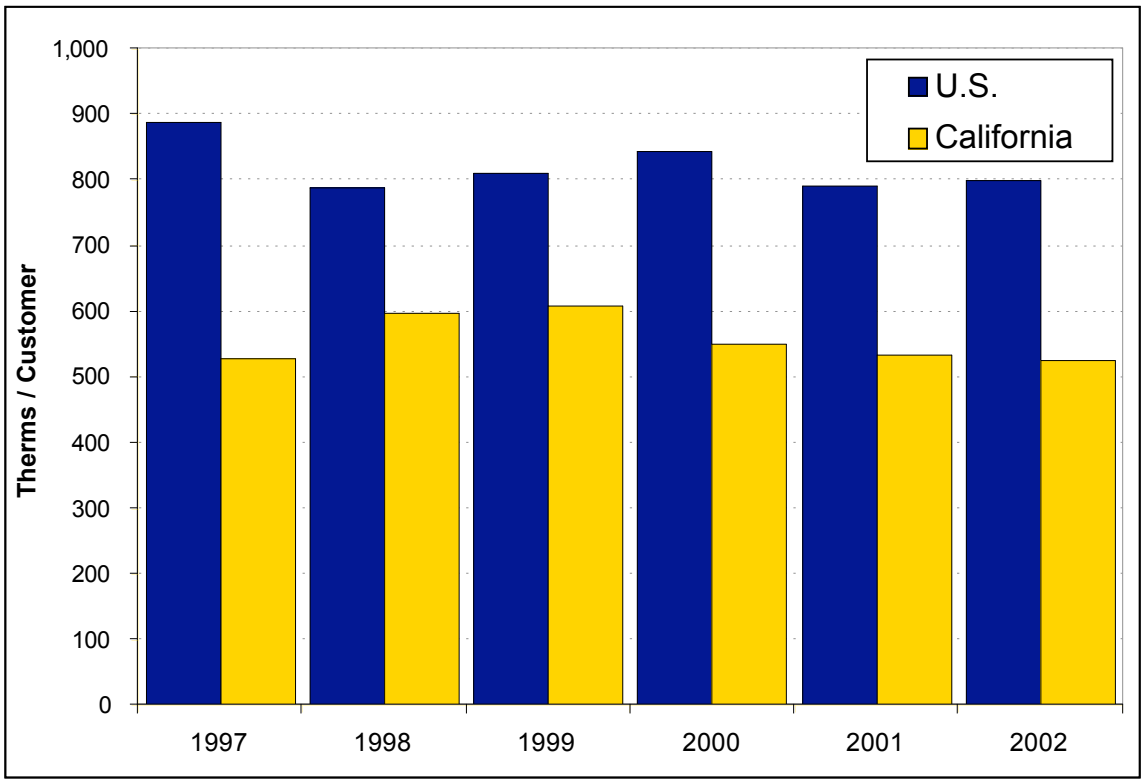

Figure 5: Natural Gas Consumption per Residential Customer
Sources: U.S. Energy Information Administration

Natural gas consumption by commercial customers has also remained relatively stable, despite California's growing population and increasing economic output, as a result of energy efficiency.

Although residential and commercial natural gas use has shown little change from year to year, it does change from month to month. Because a large portion of residential and commercial natural gas consumption is for space-heating needs, the majority of gas consumption for these two sectors takes place during the winter. Figure 6 illustrates the seasonal pattern for residential and commercial natural gas use, based on average monthly consumption between 1995 and 2002.

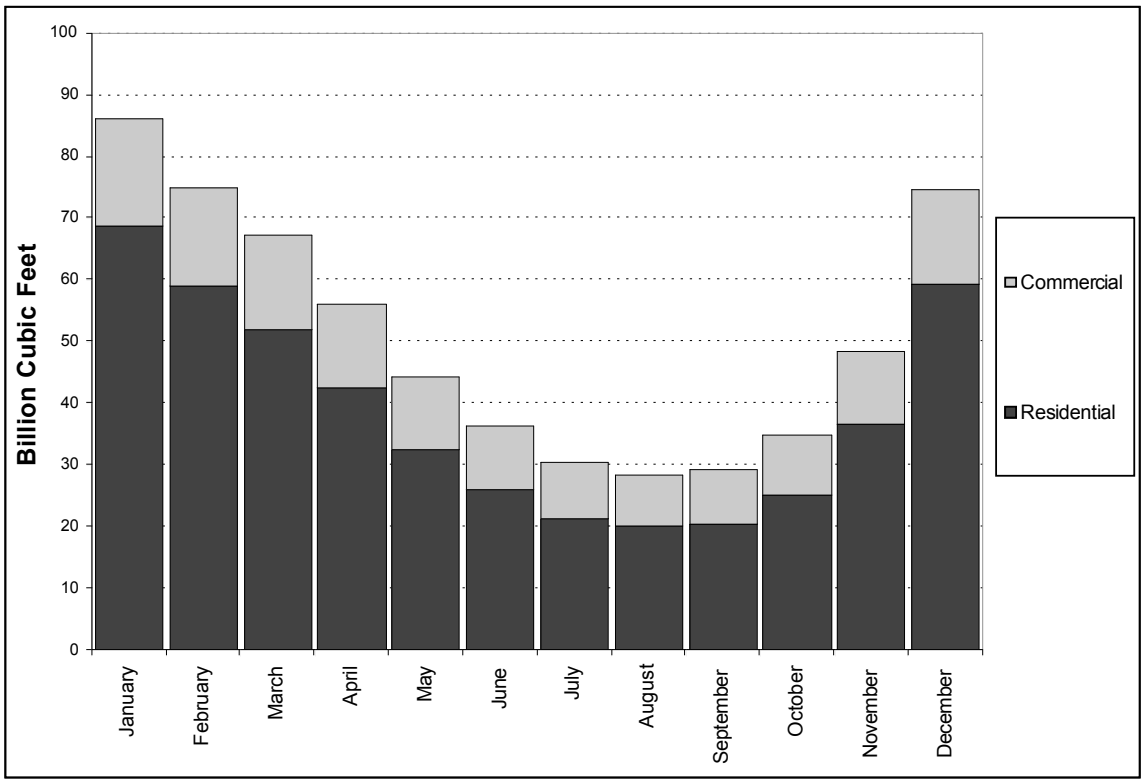

Figure 6: Seasonal Natural Gas Consumption Pattern for Residential and Commercial Customers
Source: California Energy Commission

Natural Gas Consumption by Industrial Customers

California's industrial sector includes manufacturing, mining, and agriculture. Since 1980, the industrial sector has, on average, comprised approximately one-third of the state's annual natural gas consumption. Unlike the residential and commercial sectors, natural gas consumption in the industrial sector fluctuates with economic cycles. Figure 7 shows the steady rise in industrial natural gas demand from 1992 to 1998 caused by economic growth, even as residential and commercial natural gas use remained almost flat.

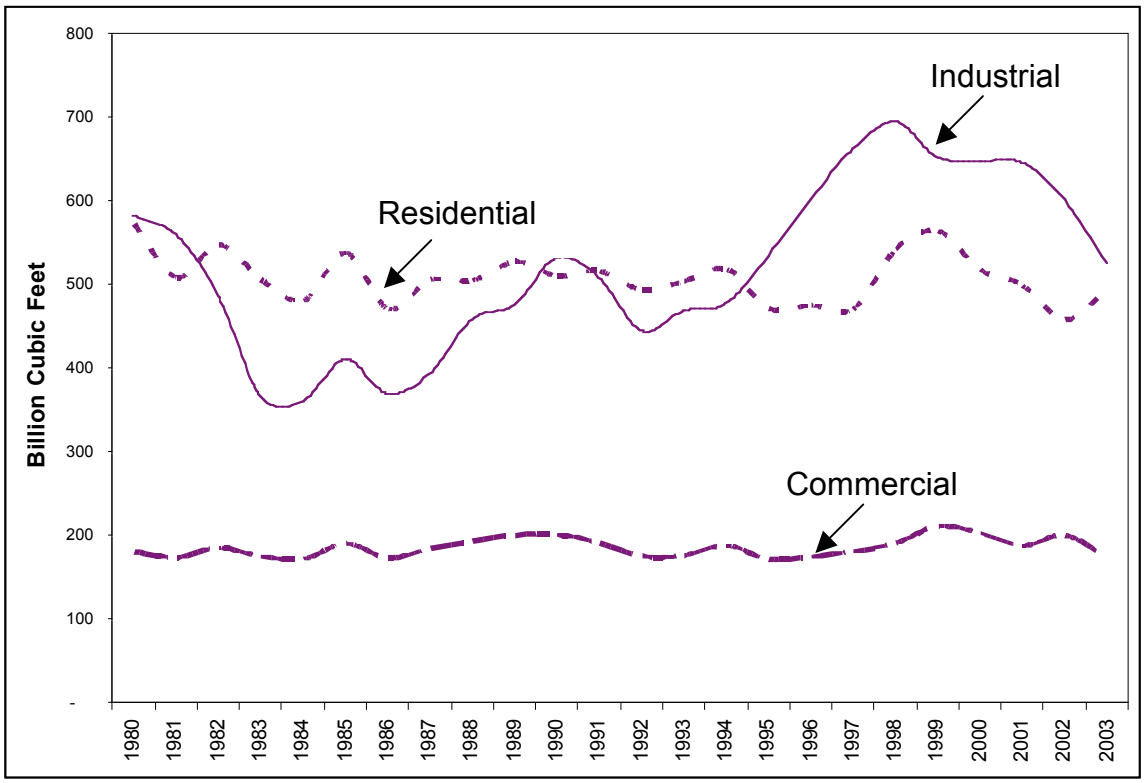

Figure 7: Natural Gas Demand Trends for Residential, Commercial, Industrial Consumers
Source: California Energy Commission

During 2003, 87 percent of natural gas consumption for manufacturing was for the following six activities:

- crude oil extraction (using natural gas-fired steam injection to enhance oil recovery);
- petroleum refining;
- food processing;
- paper production;
- glass, brick, and concrete production; and
- computer and electronic products manufacturing.

The percentage of industrial natural gas consumption for these key manufacturing industries is provided in Figure 8.

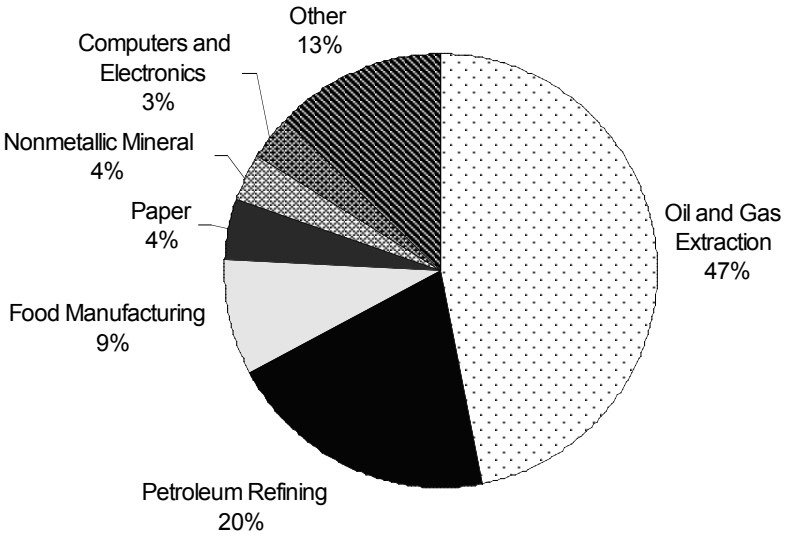

Figure 8: Natural Gas Consumption by California's Manufacturing Sector
Source: California Energy Commission

The amount of natural gas needed to manufacture $1 million worth of goods is shown in Figure 9. Compared to the U.S. as a whole, California has fewer natural-gas intensive industries.[5]

Figure 9: Industrial Natural Gas Consumption per Million Dollars of Output
Sources: U.S. Energy Information Administration and U.S. Department of Commerce, Bureau of Economic Analysis

Monthly natural gas consumption for the industrial sector is tied to industrial output rather than weather and stays relatively stable throughout the year, as shown in Figure 10. The "bump" in demand in August and September reflects natural gas demand for food manufacturing (processing).

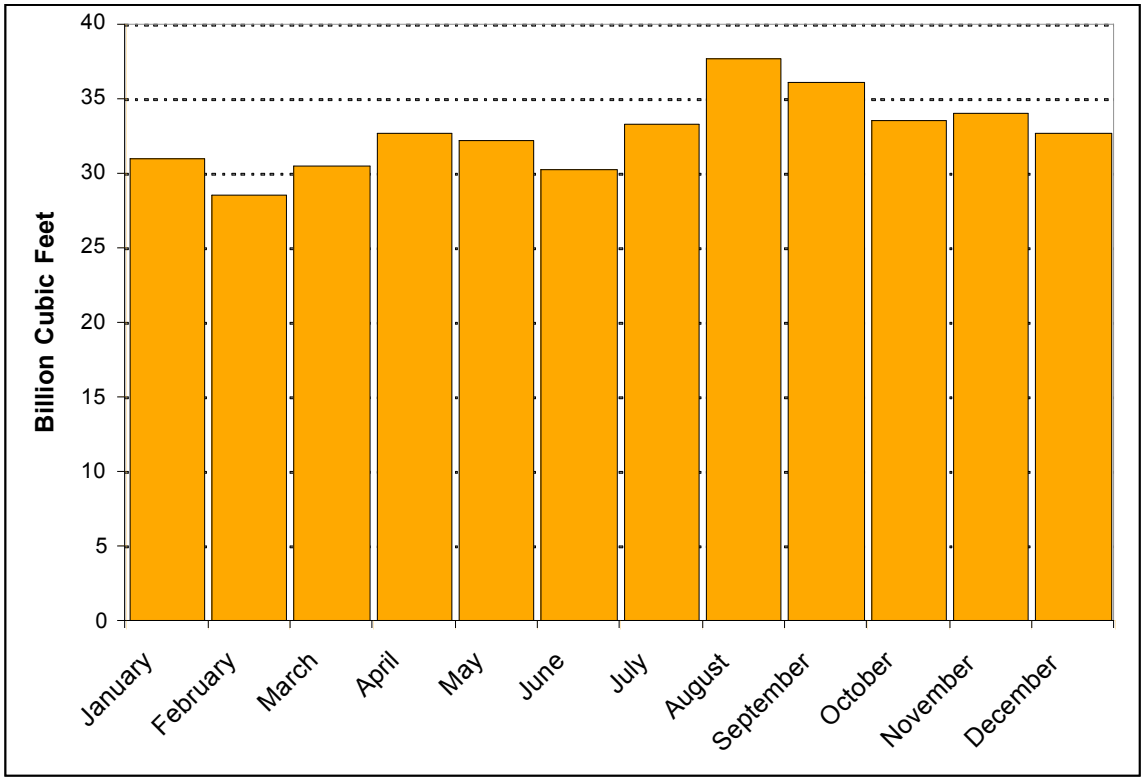

Figure 10: Monthly Natural Gas Consumption Pattern for Industrial Customers
Source: California Energy Commission

The state's agricultural sector consumes approximately one percent of the state's annual natural gas supply, primarily for crop production (e.g., heating greenhouses).

The agricultural sector also uses natural gas indirectly in the form of nitrogen fertilizer. Natural gas is an essential ingredient of anhydrous ammonia (the starting point for most nitrogen fertilizers) and represents between 80 to 90 percent of the cost to manufacture it. In 2003, California growers applied 189,000 tons of anhydrous ammonia fertilizer[6] to enhance crop production. The amount of natural gas needed to produce this quantity of fertilizer was 6.7 billion cubic feet.[7]

Natural Gas Consumption for Electricity Generation

The largest natural gas consuming sector in California is the electricity generation sector. Before 1997, natural gas consumption for electricity generation averaged 500 billion cubic feet per year. Since 1997, however, fuel use for electricity generation has exceeded 600 billion cubic feet, averaging

around 750 billion cubic feet per year. The growth in natural gas use is illustrated in Figure 11. Natural gas demand for electricity generation is projected to grow 1.5 percent per year through 2013.

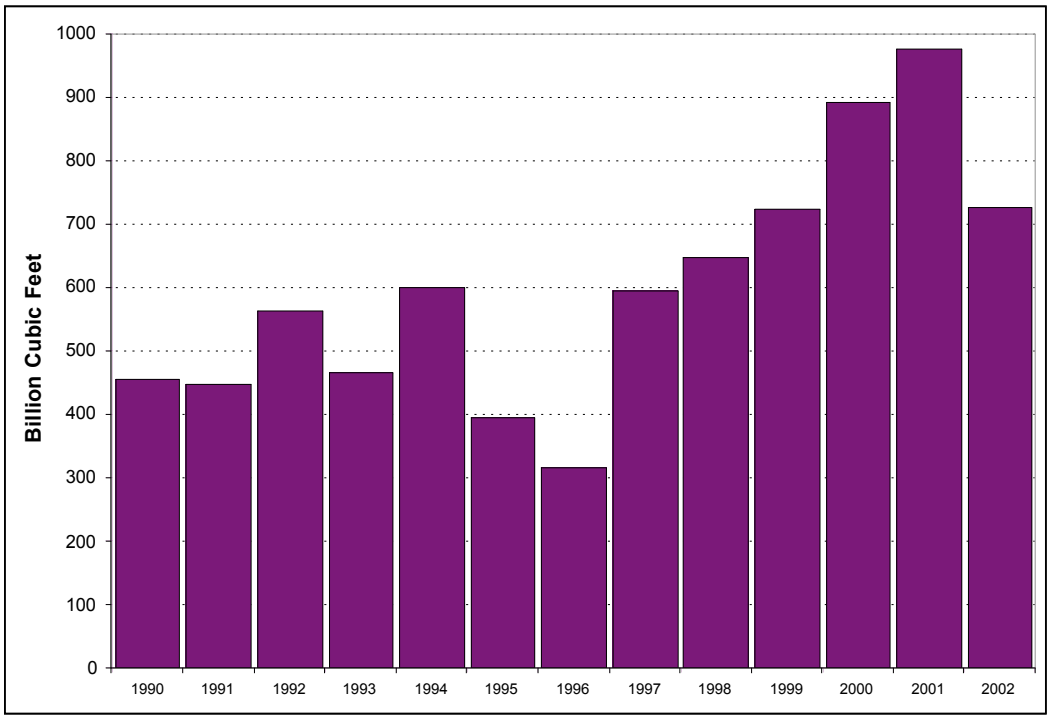

Figure 11: Total Annual Natural Gas Use for Electricity Generation
Source: California Energy Commission

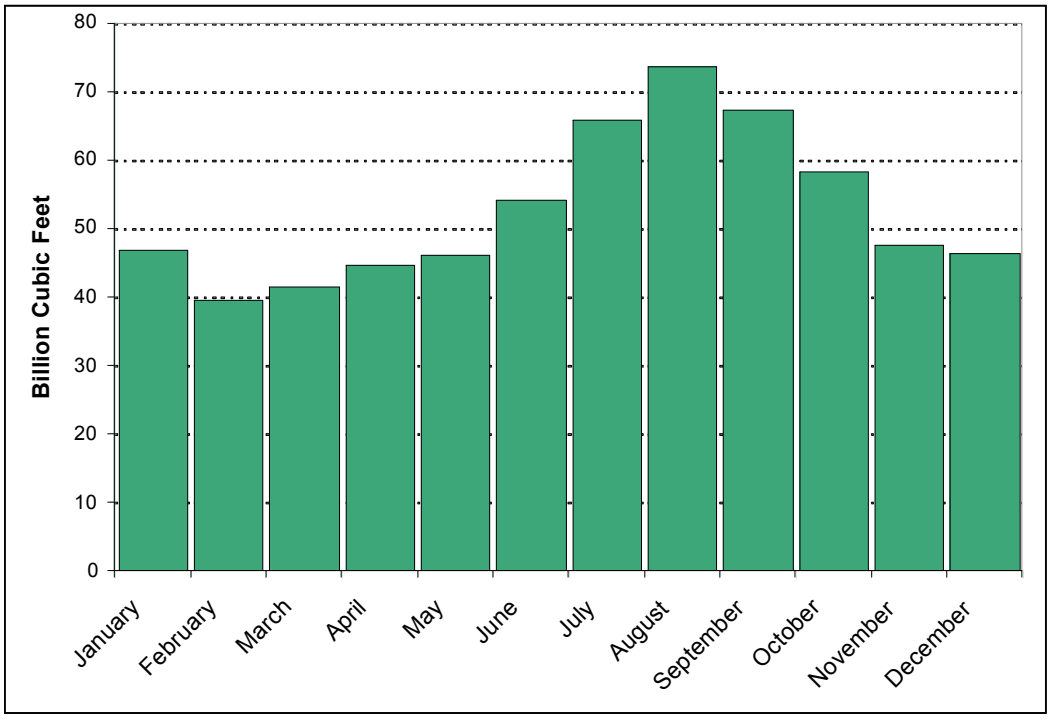

Figure 12: Seasonal Natural Gas Consumption Pattern for Electricity Generation
Source: California Energy Commission

Monthly natural gas consumption for electricity generation is tied to seasonal demand for electricity (Figure 12). Natural gas-fired power plants are dispatched to meet peak electrical demand that is created primarily by residential and commercial air conditioning loads. (Figure 12 plots average natural-gas demand for electricity generation from 1995 to 2002.)

During droughts, the state's ability to generate electricity from hydroelectric dams is diminished and natural gas-fired electricity generators must be operated more. Thus, during low hydroelectric years, natural gas demand from the electricity generation sector is even higher.

Nearly all of the new thermal power plants licensed by the California Energy Commission since 1998 have been natural-gas-fired facilities. The electricity industry has chosen the combined-cycle power plant as its preferred generating technology because of its low capital cost, fuel efficiency, and environmental performance. The capital cost of combined-cycle units has dropped over the last ten years. They can be built for about two-thirds of the capital cost of a comparably sized coal plant. The plants are also more fuel efficient using about half the amount of natural gas as older natural gas power plants to generate the same amount of electricity. High efficiency ratings represent significant fuel-cost savings and lower operating costs to the power plant owner. Lastly, greater fuel efficiency means that more electricity can be generated with fewer air pollution emissions than coal or oil-fired power plants, thereby reducing the environmental damage caused by electricity production.[8] By choosing natural-gas-fired technology, power plant developers in California have been able to meet local air quality regulations that implement the federal Clean Air Act.

The California Energy Commission's recent publication, *Aging Power Plant Report,*[9] noted that cleaner, more fuel-efficient power plants have displaced older, less efficient facilities. These older, less efficient facilities now operate mainly as peaking power plants for fewer than 100 hours per year. As a result, retiring these older facilities would achieve minimal natural gas savings.

Natural Gas as a Transportation Fuel

Although natural gas vehicles represent less than one percent of statewide natural gas demand today, the percentage is expected to grow. The transition to natural gas vehicles is being encouraged by air district regulations. For example, "fleet rules" approved by the South Coast Air Quality Management District in 2000 require that all new vehicles purchased or leased by public fleets be powered by natural gas, methanol, electricity, or fuel cells.

In April 2004, Governor Arnold Schwarzenegger signed an Executive Order to create "hydrogen highways" throughout California by the year 2010. For this vision to be implemented, hundreds of hydrogen fueling stations must be built, and used by thousands of hydrogen-powered cars, trucks, and buses. Although

hydrogen may be supplied by renewable energy sources in the future, one of the most likely fuel sources for producing hydrogen in the near-term will be natural gas.

California's Total Natural Gas Demand

Residential and commercial natural gas demand is relatively flat, while industrial natural gas demand fluctuates with the economy. California's overall natural gas demand grows at about one percent each year and is being driven primarily by the electricity generation sector (Figure 13).

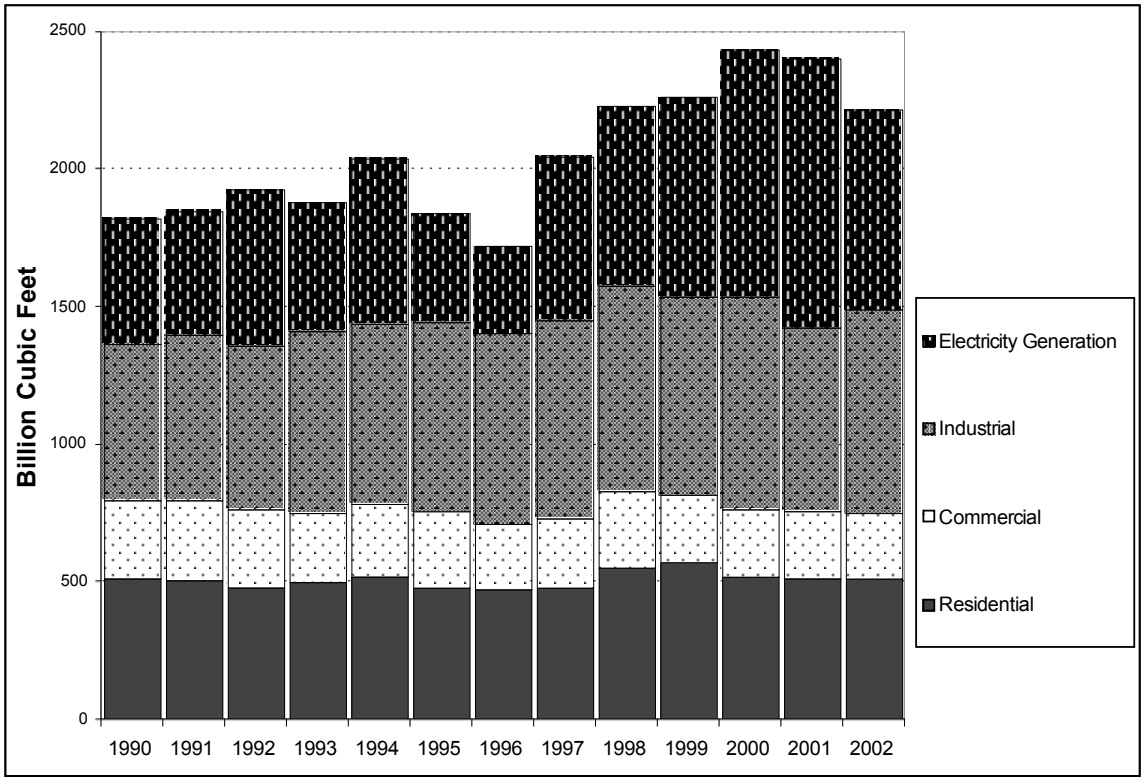

Figure 13: California's Total Annual Natural Gas Use by Economic Sector
Source: California Energy Commission

Chapter 2: California's Dependence on Natural Gas Imports

California imports approximately 85 percent, or 1.7 trillion cubic feet per year, of its natural gas supplies from other states and Canada. The four major supply sources to California are:

- Permian Basin (located in West Texas and the adjoining area of southeastern New Mexico)
- San Juan Basin (located in the Four Corners Region of the southwestern U.S.: Colorado, New Mexico, Arizona, and Utah)
- Rocky Mountains Region (includes parts of Colorado, Idaho, Montana, New Mexico, Utah, and Wyoming)
- Western Canada

Figure 14 shows the locations of these supply basins and the percentage of California's natural gas supply that these producing regions provide.

Figure 14: Sources of Natural Gas Supply to California
Source: California Energy Commission

Supplies Are Delivered by Interstate Pipelines

Southwestern supplies from the Permian Basin in West Texas and the San Juan Basin in the Four Corners region are shipped to California by three pipelines: Southern El Paso Pipeline, Questar Southern Trails Pipeline, and Transwestern Pipeline. Natural gas supplies from the Rocky Mountain region are shipped by the Kern River Pipeline. Canadian supplies are shipped over the TransCanada Gas Transmission Northwest Pipeline. California can import up to 8.3 billion cubic feet per day of natural gas using these interstate pipelines.

Figure 15 shows a map of the locations of the main interstate and intrastate pipelines serving California. It also shows a number of interstate pipelines that transport natural gas to the Midwest and East Coast from supply basins that are important to California.

California Faces Increased Competition

For the past 50 years, California has enjoyed minimal competition from the other Western states for natural gas supplies and interstate pipeline capacity, and no competition from the Midwest or Northeast for natural gas supplies.

Today, California must compete for San Juan Basin natural gas with other Western states such as Nevada, Arizona, and New Mexico, which have a faster-growing natural-gas demand and are located closer to production areas. The state also competes with the Pacific Northwest, the Midwest, and the Northeast for natural gas from Western Canada.

As new interstate pipelines are added to supply basins that primarily served California, regional competition for these supplies occurs. This competition is apparent whenever sudden increases in natural gas demand in one region affect natural gas prices for all regions served by that basin. Sudden increases in demand put a strain on production. Natural gas producers incur extra costs to increase output and these costs are reflected in higher wellhead prices. For example, a cold snap in the weather on the East Coast can cause natural gas prices to increase on the West Coast.

Interstate pipelines transport Permian Basin natural gas to states in the Southwest, California, and the Midwest, while others transport Western Canadian Sedimentary Basin gas to the Pacific Northwest, California, the Midwest, and Northeast (Figure 15). Today, when natural gas demand peaks in the Northeast or Midwest, prices will rise not only in those regions but in California as well. Interstate pipelines have created an integrated North American market.

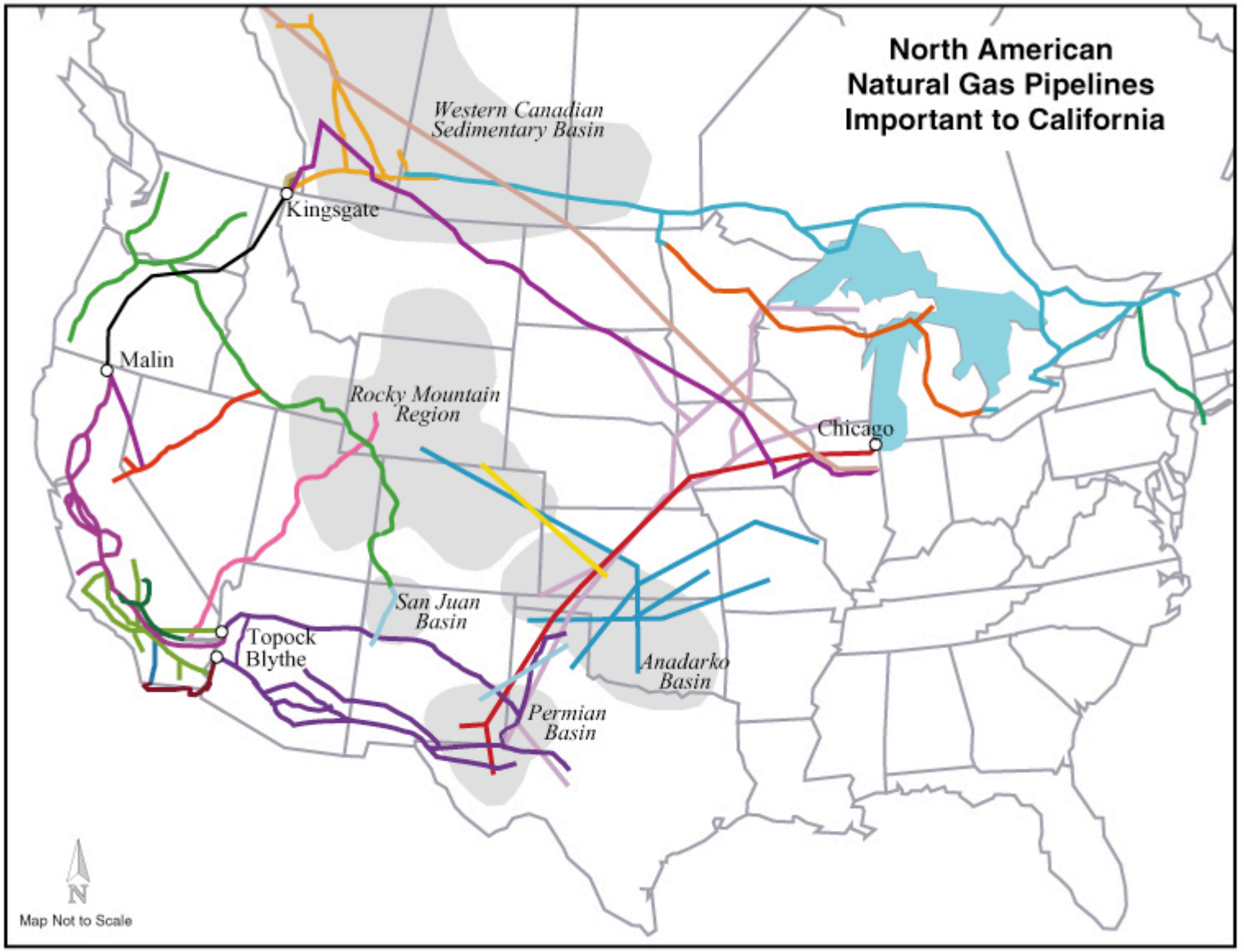

Figure 15: North American Natural Gas Pipelines Important to California
Source: California Energy Commission

Thus, California's natural gas utilities and other large natural-gas consumers (e.g., power plant owners) compete for both interstate pipeline capacity and for natural gas supplies with other regions of the country.

California's Dependence on Imports Will Increase

For the past five years, California has imported approximately 5.5 billion cubic feet per day of natural gas to keep up with demand. This supply gap is projected to increase, because in-state production has peaked and is slowly declining, while natural gas demand continues to grow slowly.

California has natural gas reserves offshore that could partially offset declining onshore production. A permanent ban prevents offshore oil and gas drilling within State waters and a moratorium through 2008 bans further leasing of offshore drilling sites in federal waters.

U.S. Natural Gas Production Has Flattened

U.S. natural gas production has been relatively flat since 1990, staying below 20 trillion cubic feet per year even though the number of wells drilled has increased approximately 80 percent (Figure 16).

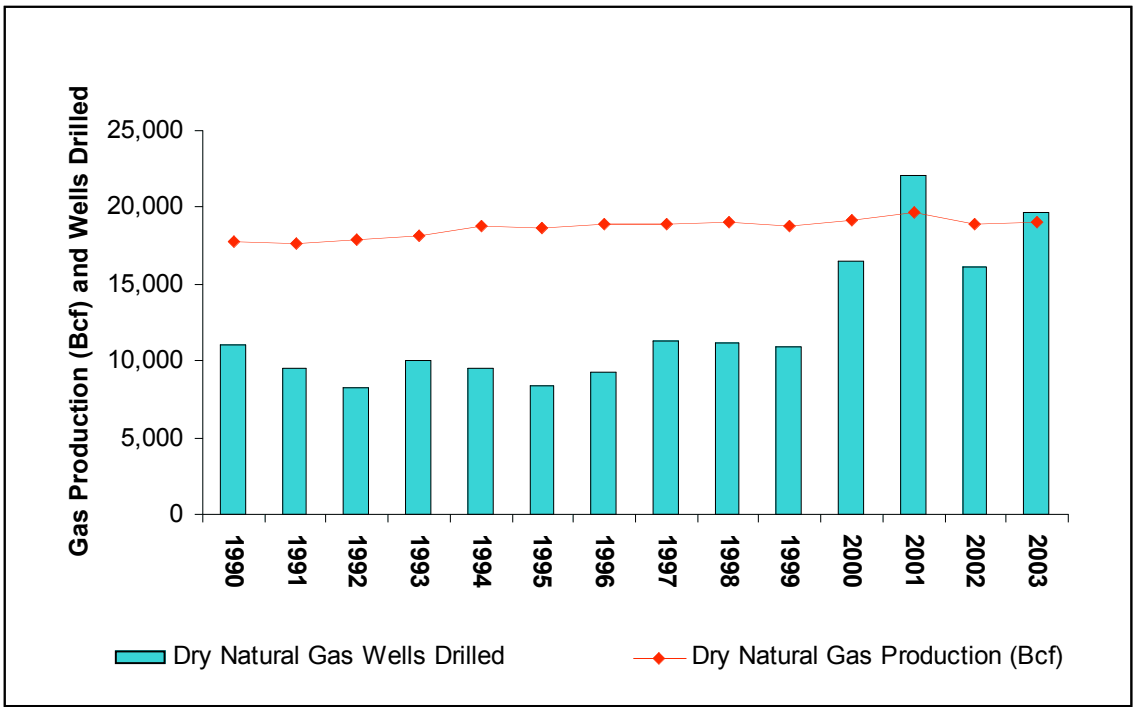

Figure 16: Comparison of Natural Gas Production to Natural Gas Well Drilling
Source: U.S. Energy Information Administration

Natural gas reserve depletion may be contributing to the apparent flattening of U.S. production. Depletion accompanies all nonrenewable resource development. As natural gas-producing areas are depleted, production falls below economic levels and new fields must be tapped to replace mature ones. These new fields, however, are usually smaller and more costly to develop. Thus, as time progresses, more effort is required to produce the same amount of gas. Advances in drilling technology have enabled producers to increase a well's first-year performance, but by extracting the gas more quickly, the well's annual production declines more rapidly in subsequent years.

The phenomenon of gas-resource depletion in North America was documented in a recent report by the National Petroleum Council (NPC) entitled, *Balancing Natural Gas Policy – Fueling the Demands of a Growing Economy*.[10]

Figure 17 illustrates the number of producing natural gas wells has increased while natural gas production from each well has steadily declined.

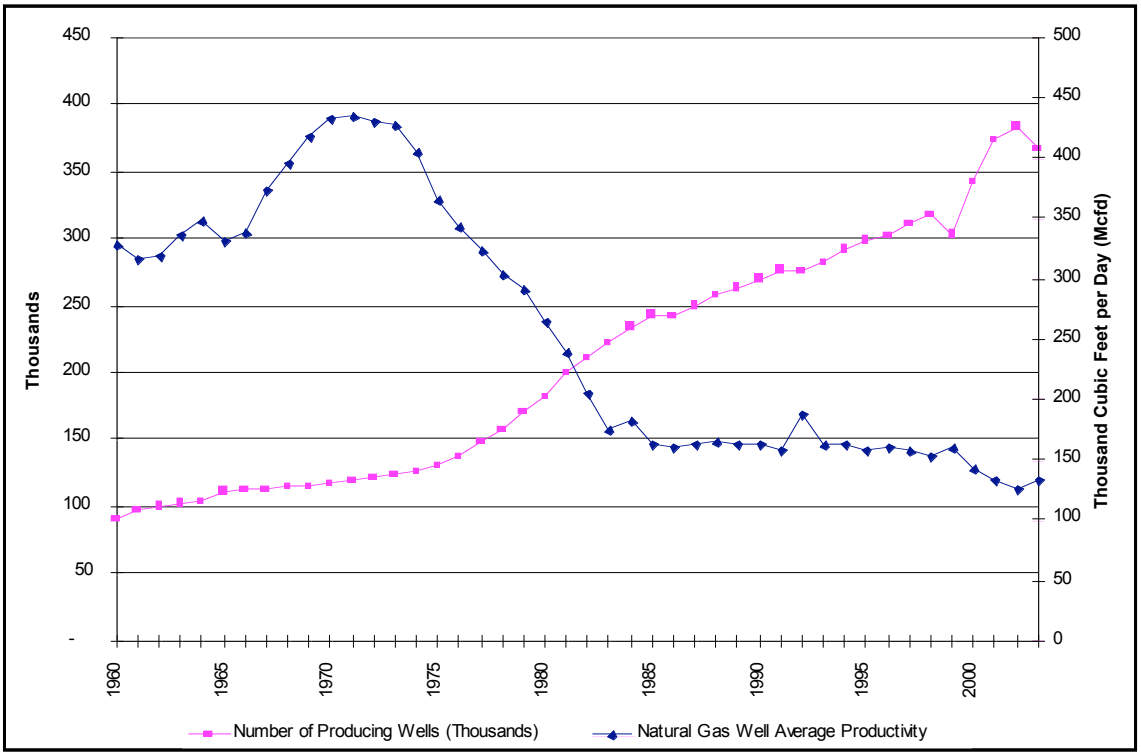

Figure 17: Producing Wells versus Natural Gas Well Average Productivity
Source: U.S. Energy Information Administration

In the mid-to-late 1990s, the U.S. had spare production capacity and was able to ramp up production quickly if demand surged. From late 2002, however, the natural gas industry has been producing natural gas at the upper limit of its productive capacity (Figure 18). Future surges in demand will have to be met by increasing reliance on natural gas already in storage and by imports.

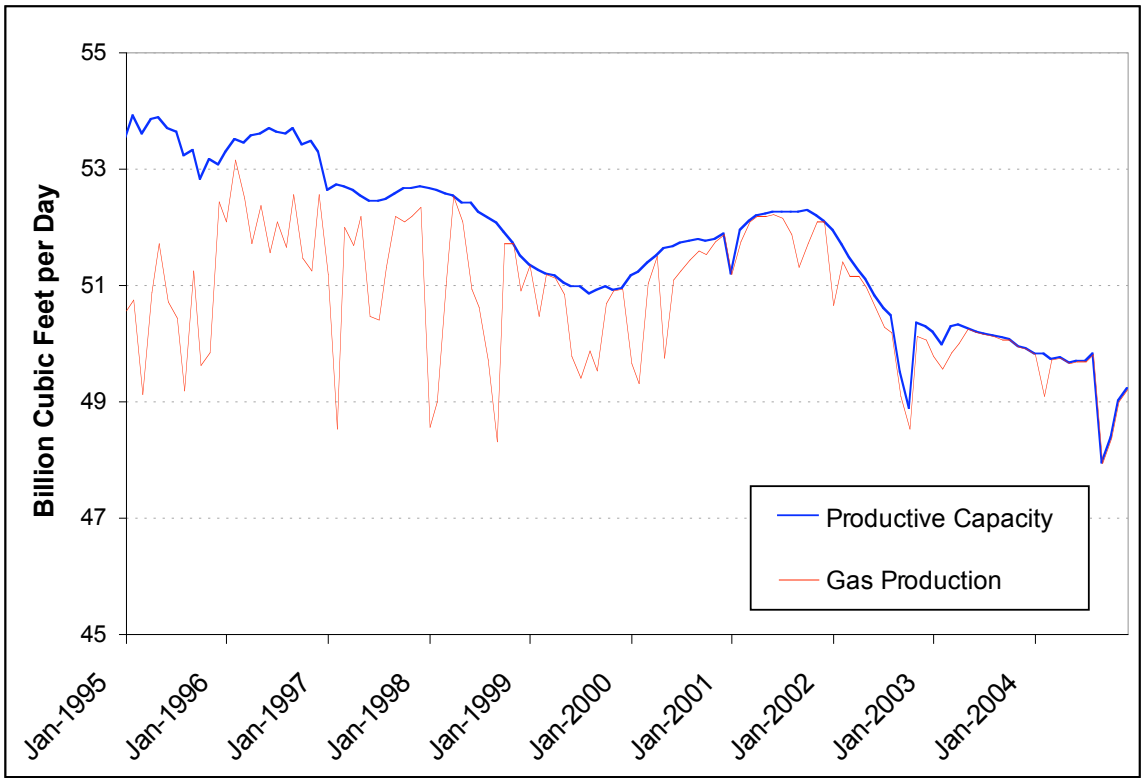

Figure 18: Lower 48 Dry Gas Production versus Dry Gas Productive Capacity
Source: Energy and Environmental Analysis, Inc.

The Canadian Natural Gas Production Bubble

Between 1980 and 2003, Canadian natural gas production grew from 2.76 trillion cubic to 6.3 trillion cubic feet - a four percent annual growth rate.[11] Although gas production increased from 4.5 trillion cubic feet to 6.3 trillion cubic feet between 1993 and 2003, it was accomplished by significantly expanding the number of gas wells from 3,239 to approximately 12,500.[12]

Natural gas in Canada is primarily located in the Western Canada Sedimentary Basin (WCSB), the largest producing region in North America. While the WCSB's production rapidly grew in the early 1990s, this growth has slowed considerably. WCSB witnessed its first year of flat-to-declining production in 2002.

Producing the Remaining North American Supplies Will Cost More

Total U.S. production has flattened, despite large increases in drilling and wellhead prices. Canada's natural gas production statistics are revealing a similar state of resource depletion. North America has ample natural gas resources today, however California's traditional supply sources (the Western Canada and the Southwest), are maturing and production is declining.

New supplies of onshore natural gas are found in small fields and wells in these fields quickly deplete supplies. Not only has the cost to drill a new well increased, the number of wells drilled each year must also grow. Maintaining the current level of production is becoming more expensive. Developing and producing the remaining sources of natural gas supply will require advances in natural gas exploration and production technology and are costly.

Imports Fill the Gap between U.S. Demand and Supply

The U. S. gap between natural gas demand and production is growing and made up with imports. Even with its optimistic projections regarding U.S. natural gas production, the U.S. EIA expects the U.S. supply-demand imbalance to grow for the next 25 years (Figure 19).

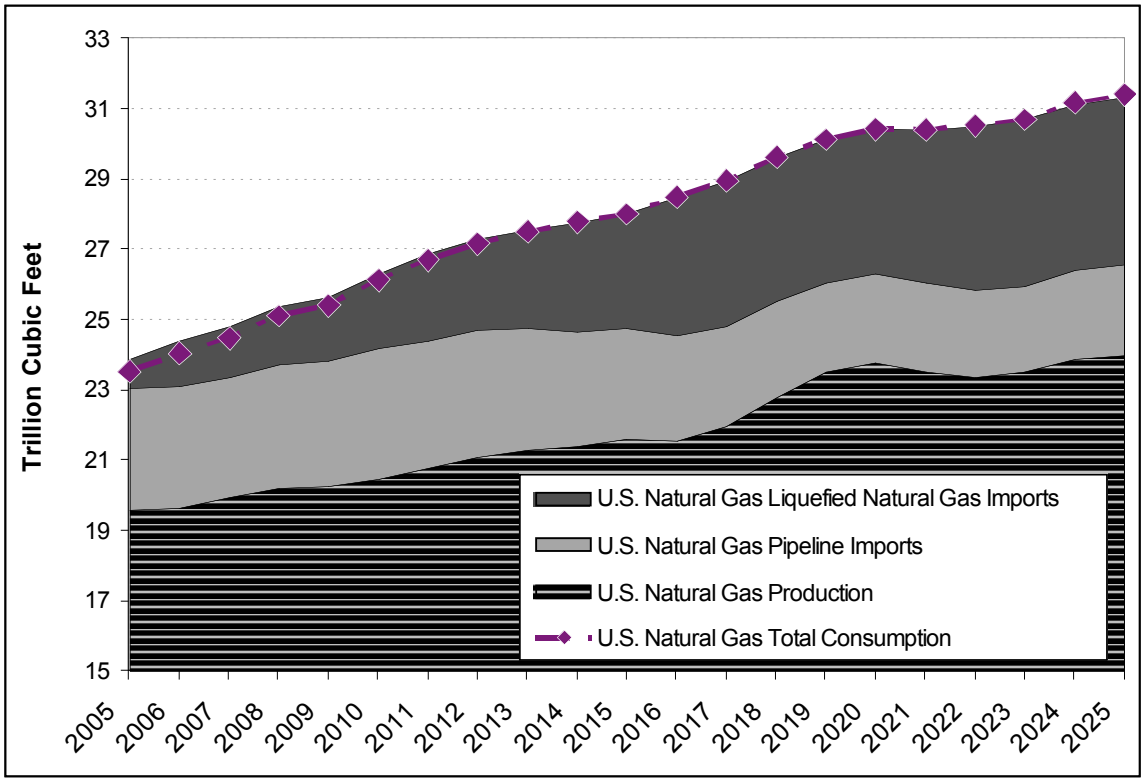

Figure 19: Projected U.S. Natural Gas Demand-Supply Balance
Source: U.S. Energy Information Administration

Chapter 3: Natural Gas Prices in California

Today's relatively high natural gas prices reflect the costs to produce it from maturing, North American resource basins and interstate competition to meet growing national demand. Rising prices affect individual consumers and businesses differently, but the potential cumulative impact upon the state economy is a cause for concern.

U.S. Supply-Demand Imbalance Affects Natural Gas Prices

Since 2000, the balance between U.S. natural gas supply and demand has tightened substantially due to a number of events, including:

- A decline of natural gas production capacity eliminating the natural gas supply "gas bubble" (surplus),
- The construction of many natural gas-fired electricity generators since 1999 with limited capability to switch to an alternative fuel (e.g., oil), and
- A rebound in the U.S. economy in 2003 after negative and slow growth in 2001 and 2002.

Wholesale natural gas prices in California and the U.S. have doubled since July, 2002, reflecting this precarious balance between available supplies and demand. These prices reflect the competitive U.S.-Canadian natural gas market, where the "marginal" or most expensive natural gas wells needed to supply the last increment of demand set the price for much of our natural gas. Thus, unless demand falls to a level that avoids the need to develop the most expensive wells, natural gas prices will remain high, and may increase further over time as even more expensive wells are developed.

Rising Natural Gas Prices Affect California Consumers

National markets, over which California has little influence, set the prices California consumers pay for natural gas. Additionally, California's natural gas utilities pass through any increased natural gas costs to their "core" customers - residential, small commercial and industrial sectors. As illustrated in Figure 20, the prices paid by California's natural gas utilities have steadily increased for several years.

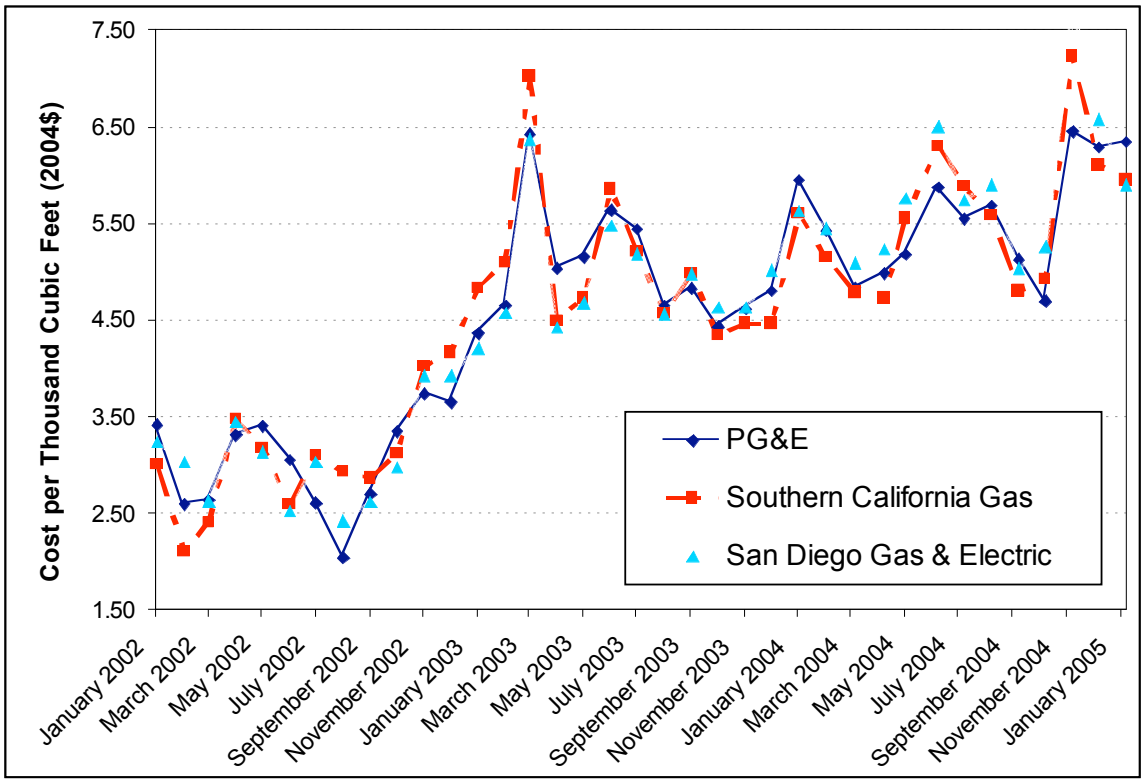

Figure 20: California's Natural Gas Utilities' Cost of Gas, 2002 to 2004
Sources: PG&E, Southern California Gas Company, and San Diego Gas & Electric Company

Rising natural gas prices directly affect California's economy and consumers. High gas prices increase consumers' cost of living and reduce their purchasing power for other goods and services. Californians feel the effects of rising natural gas prices with more expensive home heating and electricity bills, and higher prices for food and consumer goods. According to a 2004 Mortgage Bankers Association Economic Commentary, "High energy prices act as a tax on consumers…that …tend[s] to slow consumer spending..."[13]

Higher natural gas prices also add to the cost of California-made products, making our state's businesses less competitive in the global marketplace. These increased natural gas prices cause California consumers and businesses to pay billions of dollars more (Figure 21).

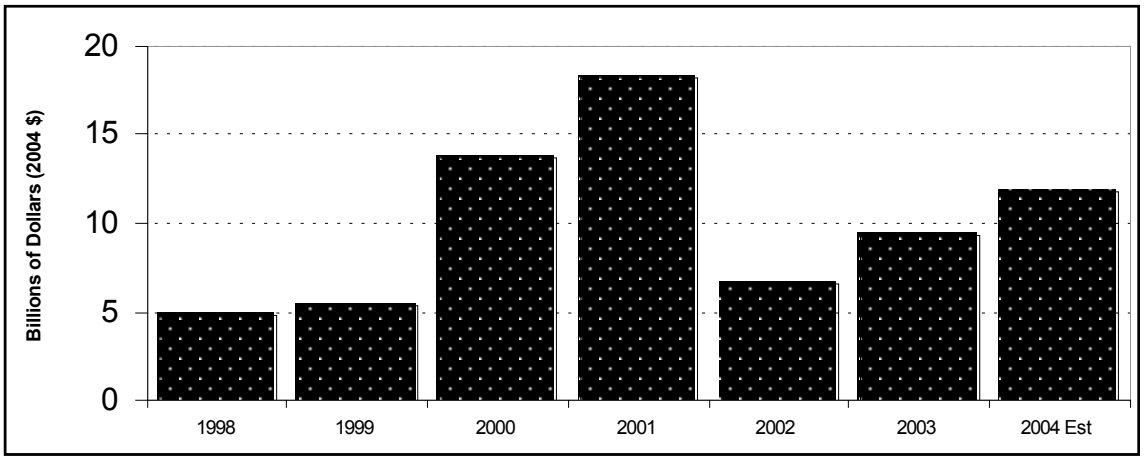

Figure 21: Estimated Total Annual Expenditures for Natural Gas in California
Source: California Energy Commission

During the electricity crisis in 2000 and 2001, statewide expenditures for natural gas exceeded $13 billion and $18 billion, respectively. Although 2002 saw a significant drop in total expenditures to $6.6 billion, by 2004, costs for natural gas had increased to around $12 billion. This estimate does not include the costs to transport natural gas to California by interstate pipelines.

Rising Natural Gas Prices Affect California's Economy

California, despite recent economic challenges, stands as the fifth largest economy.[14]

California industries and commercial businesses that rely heavily on natural gas are concerned that high natural gas prices will persist, adding to the cost of California-made products and services as well as doing business in the state.

According to the Director of Energy Economics and Microeconomic Policy Analysis for the Federal Reserve Bank of Dallas, "Sustained high natural gas prices are likely a drag on U.S. economic activity…As such, rising natural gas prices can result in a classic supply-side shock that reduces potential output. Consequently, …productivity growth [is] slowed. The decline in productivity growth lessens real wage growth and increases the unemployment rate at which inflation accelerates."[15]

The American Chemistry Council (ACC) claims that high natural gas prices damage the competitiveness of energy-intensive industries that use gas for fuel and as a raw material to make products. Greg Lebedev, President of the ACC, warned of a possible recession for his industry when he said, "No company [or] industry… can absorb a three-fold increase in major raw material prices and continue to compete in the global marketplace…and no economy teetering on the edge of recession can hang onto its recovery. In fact, every recession since World War II has been preceded by this sort of run-up in energy costs."[16]

Rising Natural Gas Prices Could Lead to "Demand Destruction"

If the cost of doing business becomes too high for gas-intensive industries and commercial businesses to earn a profit, they may move their operations to other countries where costs are more affordable. This permanent loss of natural gas customers is called "demand destruction."

According to Paul Cicio of the Industrial Energy Consumers of America, the most natural gas price-sensitive industries in the U.S. manufacturing sector produce the following goods: aluminum, automobiles, brick, cement, chemicals, computers, cosmetics, detergents, fertilizer, food processing, glass/ceramics, industrial gases, medical supplies, paint, pharmaceuticals, plastics, pulp and paper, steel, and telecommunications equipment.

The Fertilizer Institute has documented the "demand destruction" occurring in its industry due to "skyrocketing and highly volatile natural gas prices." In a 2003 press release, it reported that 11 ammonia plants, representing 21 percent of U.S. capacity have been closed since mid-2000 when the natural gas crisis began. And, in 2003, only 50 percent of the remaining nitrogen fertilizer industry's capacity was operating.[17] U.S. growers, many in California, must import nitrogen fertilizers from overseas because of the loss in U.S. fertilizer-manufacturing capability.

Chapter 4: Addressing Rising Natural Gas Prices in California

The *2003 Energy Report* established a preferential order of options as the State's energy policy for meeting existing energy demand as well as for addressing future energy demand. The five options are listed and described, below.

1. Energy Efficiency Strategies

Energy efficiency is the preferred first option because it is regarded as the least-cost approach to meeting energy needs.

More stringent building and appliance efficiency standards –
The estimated gas-savings impacts from the 2005 California Building and Appliance Energy Efficiency Standards is approximately 0.1 million cubic feet per year, approximately three-fourths of which would be realized in the new residential construction sector. Examples of new natural gas-efficiency requirements include: gas furnaces must meet federal minimum efficiency standards, hot-water pipes must be insulated, and air handling ducts must be installed properly and insulated.

Energy audits and financial assistance –
An April 2003 study[18] assessed the natural gas energy-efficiency potential in existing residential buildings. It found that deploying 20 selected efficiency measures in residential buildings, wherever they were both technically and economically feasible, could potentially save more than 40 percent of residential gas use. A companion study[19] in May 2003 assessed the natural gas-savings potential in existing commercial buildings. It concluded that if 26 gas-efficiency measures were installed wherever feasible, gas consumption in existing commercial buildings could be reduced by more than 20 percent.

Although existing homes and commercial businesses can typically save 20 percent on their natural gas bills by adopting cost-effective efficiency measures, few building owners will pursue these opportunities without technical support (e.g., energy audits) and financial assistance (e.g., rebates or low-interest loans).

Currently, natural gas utility ratepayers pay a "public goods charge" as part of their monthly utility bills to fund utility-conducted rebate programs. In December 2004, the California Public Utilities Commission (CPUC) authorized the utilities to increase their collection of "public goods charge" funds to expand current natural-gas efficiency programs.[20] "Public goods charge" funds are also collected by California utilities for electrical energy-efficiency programs.

Electricity efficiency policies and programs –
Saving electricity also saves the natural gas used to generate it. Many natural gas-fired power plants are operated only to generate electricity during periods of peak electrical demand, so reducing peak electrical demand is particularly helpful in reducing natural gas consumption by electricity generators.

The Energy Commission updates the Building Energy Efficiency Standards every three years. Additional natural gas savings could be achieved by adopting more stringent building and appliance efficiency standards in 2008.

The CPUC could also authorize the electric utilities to adopt new electricity rates that more closely reflect the actual cost of electricity used during the electric utility's peak-demand period. "Dynamic pricing" is a retail electricity rate characterized by one or more "dispatchable" prices intended to modify demand. The dispatched price would be based on instantaneous conditions of the utility's system.

2. Displace Natural Gas-fired Power Plants with Renewable Energy

Alternatives to natural gas-fired power plants include electricity generators powered by renewable energy resources such as wind, geothermal, biomass, small hydroelectricity, solar photovoltaics, and solar thermal. The California Renewables Portfolio Standard establishes targets for increasing the percentage on electricity sold in California from renewable energy facilities. By 2017, 20 percent of electricity purchases must be from renewable energy facilities. This amount of renewable energy will save an estimated 500 million cubic feet per day of natural gas that would have been used to produce electricity.

The Energy Commission also analyzed the impact of achieving the 20 percent target by 2013 using a combination of additional renewables and conservation (Figure 22). The analysis determined that demand for natural gas by electricity generators will continue to grow, even if the target date were accelerated.

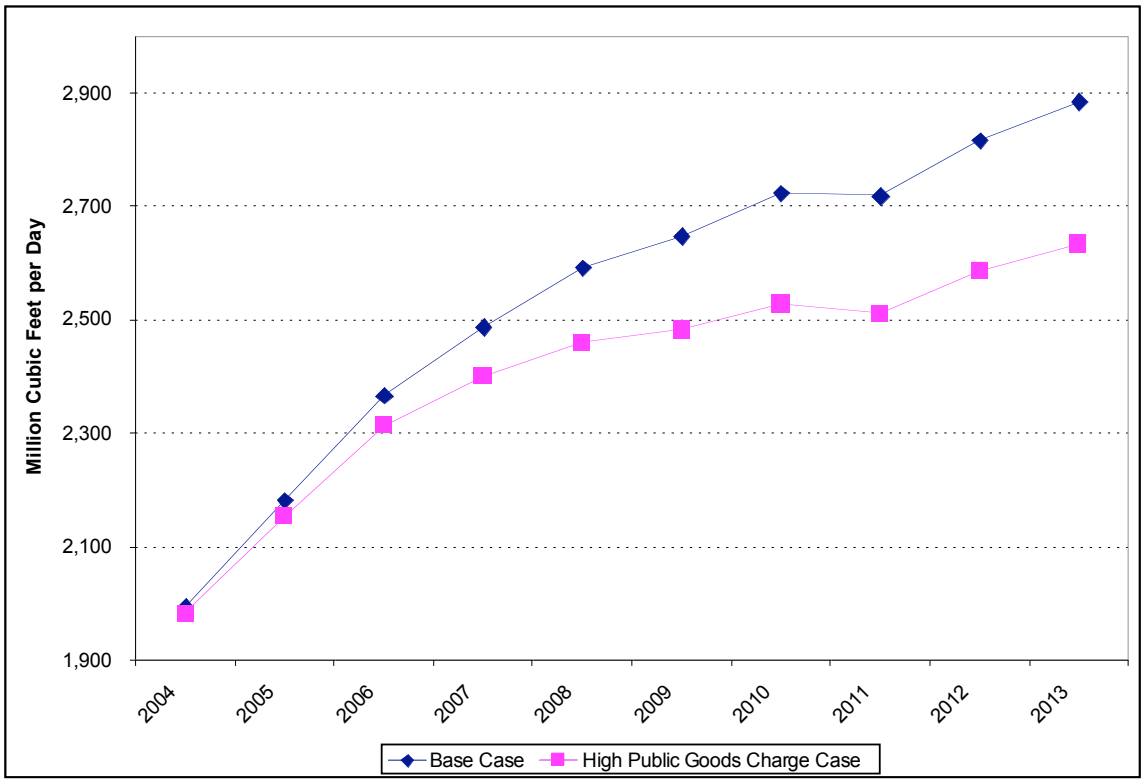

Figure 22: Comparison of Natural Gas Demand for Electricity Generation — Base Case versus High Public-Goods-Charge-Case Assumptions
Source: California Energy Commission, *2003 Energy Report*

3. Deploy Small-Scale, "Distributed" Generation

The CPUC authorized the state's investor-owned utilities to establish the "Self Generation Program" that provides financial assistance to ratepayers to install on-site electricity generators. The advantage of using distributed generation is that it avoids potential electricity losses associated with transmitting power from central-station power plants by bringing electricity production closer to where it is consumed.

Examples of commercially available distributed generation technologies include natural gas-fired fuel cells and cogeneration equipment and solar photovoltaic systems.

In addition to the "Self Generation" program, the Energy Commission's Renewables Program provides a "buy-down" (rebate) for solar photovoltaic installations. Approximately 11,000 solar photovoltaic systems have been installed in California to date, due to the Energy Commission's program. The "Million Homes Solar" Plan, announced by Governor Schwarzenegger in August 2004, will encourage installation of solar panels in one million roofs in California over the next 13 years, representing 2,700 megawatts of installed electricity generation.

4. Increase Domestic Supplies of Natural Gas from Unconventional and Remote Sources

Additional supplies of natural gas will not likely come from conventional sources. Conventional sources may be the easiest to develop, but they have the least amount of recoverable resources. Instead, the potential gap between future demand and supply will likely be filled in part by unconventional sources that are facilitated by advances in exploration and production technology. Technological advances are necessary for developing all unconventional resources, but the most challenging, but potentially largest unconventional resources will be developed last: natural gas hydrates.

Examples of more near-term unconventional sources within the U.S. include coalbed methane. Currently, coalbed methane is being produced from nine mature and emerging basins, such as the San Juan Basin and the Powder River Basin in Wyoming.

In addition to developing coalbed methane, the natural gas industry is proposing to develop Arctic gas from Alaska and the MacKenzie Delta in Canada. These sources could become supply options for California as well. It is doubtful, however, that the Alaskan pipeline that will deliver this natural gas prior to 2012. Canada is proceeding with its plans for a pipeline project from the MacKenzie Valley to Boundary Lake, where it could connect with Alliance Pipeline, TransCanada Pipeline, Northern Border Pipeline and others. Thus, California will have an opportunity to compete for MacKenzie Delta supplies when it becomes available in 2010.

5. Import Natural Gas Supplies from Overseas

Another option is to import additional natural gas supplies from overseas. For California to access natural gas from Pacific Rim countries, such as Australia, Indonesia, and Russia, the West Coast must have receiving terminals to obtain these imports. Terminal sites have been proposed in British Columbia, Oregon, California, and Baja California, Mexico.[21]

Chapter 5: Conclusions

California consumes a significant share of the world's natural gas supplies and its demand for natural gas is forecasted to grow one percent per year through 2013. The primary contributor to the state's demand growth is the use of natural gas as fuel for electricity generation. In addition, natural gas is an important fuel for the state's industrial sector and is the preferred fuel for residential and commercial heating needs.

California relies upon imports to meet 85 percent of its demand for natural gas. In the future, California will face growing competition from other Western States and the Midwest for natural gas supplies and interstate pipeline capacity. To compete successfully against other states, California consumers will be expected to pay higher natural gas prices and pipeline transportation rates.

Today's high natural gas prices reflect declining supplies, increased competition from other states to satisfy the regional natural gas demand, and the dominance of the U.S. natural gas market upon California prices. In the future, natural gas prices can be expected to continue increasing unless demand is lowered or imports increase to boost available supplies.

The cost of producing North American natural gas has been increasing, because existing sources of supply are located in resource basins that are maturing. The remaining resources are now in smaller natural gas fields that deplete more quickly. To maintain current levels of production, more wells must be drilled every year.

State energy policy puts an emphasis upon reducing natural gas demand and dependence upon natural gas-fired electricity generation. The Energy Commission has strengthened the Building and Appliance Energy Efficiency Standards and the California Public Utilities Commission has increased ratepayer funding for natural gas energy efficiency and distributed generation programs. In addition, the State has committed to increasing the proportion of electricity sold in the state that is produced by renewable energy technologies. Despite these energy efficiency, distributed generation, and renewable energy programs, the state's natural gas demand is expected to continue growing gradually.

Options to increase supply include increased drilling of more expensive natural gas resources, including unconventional resources and those in Arctic North America. These resources, however, do not represent near-term solutions, because they will require technological advances and the construction of major new interstate pipelines, respectively. Natural gas could also be imported to California from other countries in the Pacific Rim as liquefied natural gas. This option is not viable until receiving terminals are built on the West Coast.

End Notes

[1] "California Natural Gas Consumption by End Use," http://tonto.eia.doe.gov/dnav/ng/ng_cons_sum_dcu_SCA_m.htm.
[2] *California Statewide Residential Appliance Saturation Study: Final Report Executive Summary,* Consultant Report prepared for the California Energy Commission by KEMA-XENERGY, Itron, and RoperASW, June 2004, Publication No. 400-04-009.
[3] *California Statewide Residential Appliance Saturation Study: Final Report Executive Summary,* Consultant Report prepared for the California Energy Commission by KEMA-XENERGY, Itron, and RoperASW, June 2004, Publication No. 400-04-009.
[4] See http://www.socalgas.com/construction/eah.shtml.
[5] The North American Industry Classifications used to produce this figure were the following: 11 (Mining), 21 (Oil and Gas Refining), 23 (Construction), and 31 through 33 (Manufacturing).
[6] Personal communication, Christina Mullens, California Department of Food and Agriculture, Agricultural Commodities and Regulatory Services, January 10, 2005.
[7] Approximately 35 million cubic feet of natural gas is needed to produce 1,000 tons of nitrogen fertilizer.
[8] Excerpted from *The Advantages of Combined Cycle Plants: A 'New Generation' Technology*, by Gráinne Ryder, Probe International, Toronto, Canada, November 1997, http://www.probeinternational.org/pi/documents/Mekong/psr2.htm.
[9] http://energy.ca.gov/2004_policy_update/documents/index.html
[10] http://www.npc.org/
[11] International Natural Gas Production Data, loc.cit.
[12] "The Natural Gas Production Treadmill," by Bill Powers, *Canadian Energy Viewpoint*, October 30, 2003, http://www.financialsense.com/editorials/powers/2003/1030.html.
[13] "Rising Energy Prices: A Quandary for the FED," Mortgage Bankers Association Economic Commentary, Issue 116, June 2004, http://www.mortgagebankers.org/marketdata/econ.comm/ec0604.html.
[14] This ranking is based upon gross domestic product data from the World Bank and a California gross state product estimate from the UCLA Anderson Forecasting Project. Gross product is a measure of the output of all goods and services produced by an economy. Source: California Department of Commerce, <http://commerce.ca.gov/ttca/pdfs/detail/ersi/GSP-Ranking.pdf>.
[15] "U.S. Natural Gas Markets in Turmoil," by Stephen P.A. Brown, Director of Energy Economics and Microeconomic Policy Analysis, Federal Reserve Bank of Dallas, as testimony prepared for a hearing on the Scientific Inventory of Oil and Gas Resources on Federal Lands, The Subcommittee on Energy and Mineral Resources, Committee on Resources, House of Representatives, June 19, 2003, http://resourcescommittee.house.gov/108cong/energy/2003jun19/brown.htm.
[16] "Gas Crisis Talk Rattles Confidence in Nation's Economy," by Kenneth Betz, Energy User News, March 27, 2003, http://www.energyusernews.com/CDA/ArticleInformation/coverstory/BNPCoverstoryitem/0,2582,95173,00.html.
[17] "Natural Gas Prices Exacting Heavy Toll on U.S. Fertilizer Producers and Retailers," The Fertilizer Institute, March 6, 2003, http://www.tfi.org/Media/natural%20gas%20letters%20press%20release%20_final_%20-%20mar%206%20-%20km.pdf.
[18] "California Statewide Residential Sector Energy Efficiency Potential Study," Study ID #SW063, prepared for Rafael Friedmann, Project Manager, Pacific Gas and Electric Company, prepared by Fred Coito and Mike Rufo, KEMA-XENERGY Inc., April 2003.
[19] "California Statewide Commercial Sector Natural Gas Energy Efficiency Potential Study," Study ID #SW061, prepared for Chris Ann Dickerson, Project Manager, Pacific Gas and Electric Company, prepared by KEMA-XENERGY Inc., May 14, 2003.
[20] http://www.cpuc.ca.gov/PUBLISHED/NEWS_RELEASE/41878.htm
[21] For project descriptions, see http://www.energy.ca.gov/lng/documents/2004-09-24_LNG_PROJECTS.XLS.